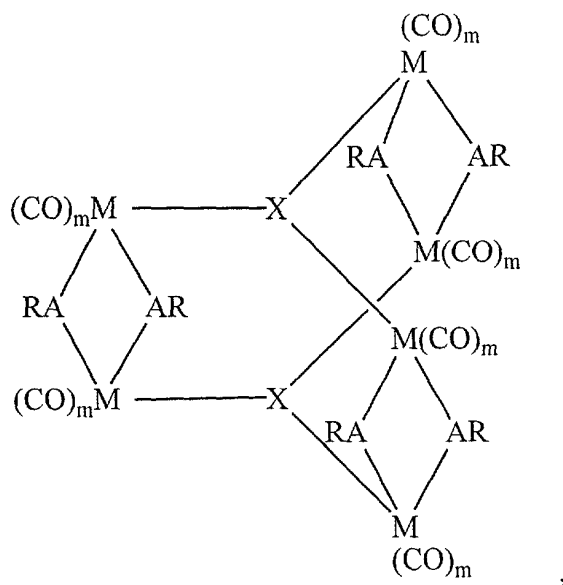


**WHAT IS CLAIMED IS:**

1. A prismatic supramolecule having the following structure:



wherein

M is Re, Mn, Cr, Mo, W, Fe, Ru, or Os,

X is a nitrogen-based tridentate ligand;

A is O, S, Se, or Te;

R is  $C_1\sim C_{16}$  alkyl,  $(CH_2)_n$ -aryl, or  $(CH_2)_n$ -aryl- $(O-C_1\sim C_{16}$  alkyl) $_p$ , in which n is 0-15, p is 1-3; and

m is 1, 2, 3, 4, or 5.

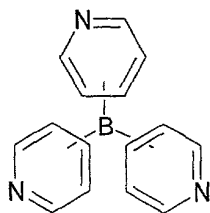
2. The prismatic supramolecule of claim 1, wherein M is Re.

3. The prismatic supramolecule of claim 2, wherein m is 3.

4. The prismatic supramolecule of claim 1, wherein R is  $C_1\sim C_{16}$  straight chain alkyl.

5. The prismatic supramolecule of claim 1, wherein A is O.

6. The prismatic supramolecule of claim 1, wherein X is triazine or a ligand of the formula:



wherein B is alkyl, alkenyl, alknyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

5

7. The prismatic supramolecule of claim 6, wherein X is 1,3,5-triazine.

8. The prismatic supramolecule of claim 7, wherein X is 2,4,6-tri-4-pyridyl-1,3,5-triazine.

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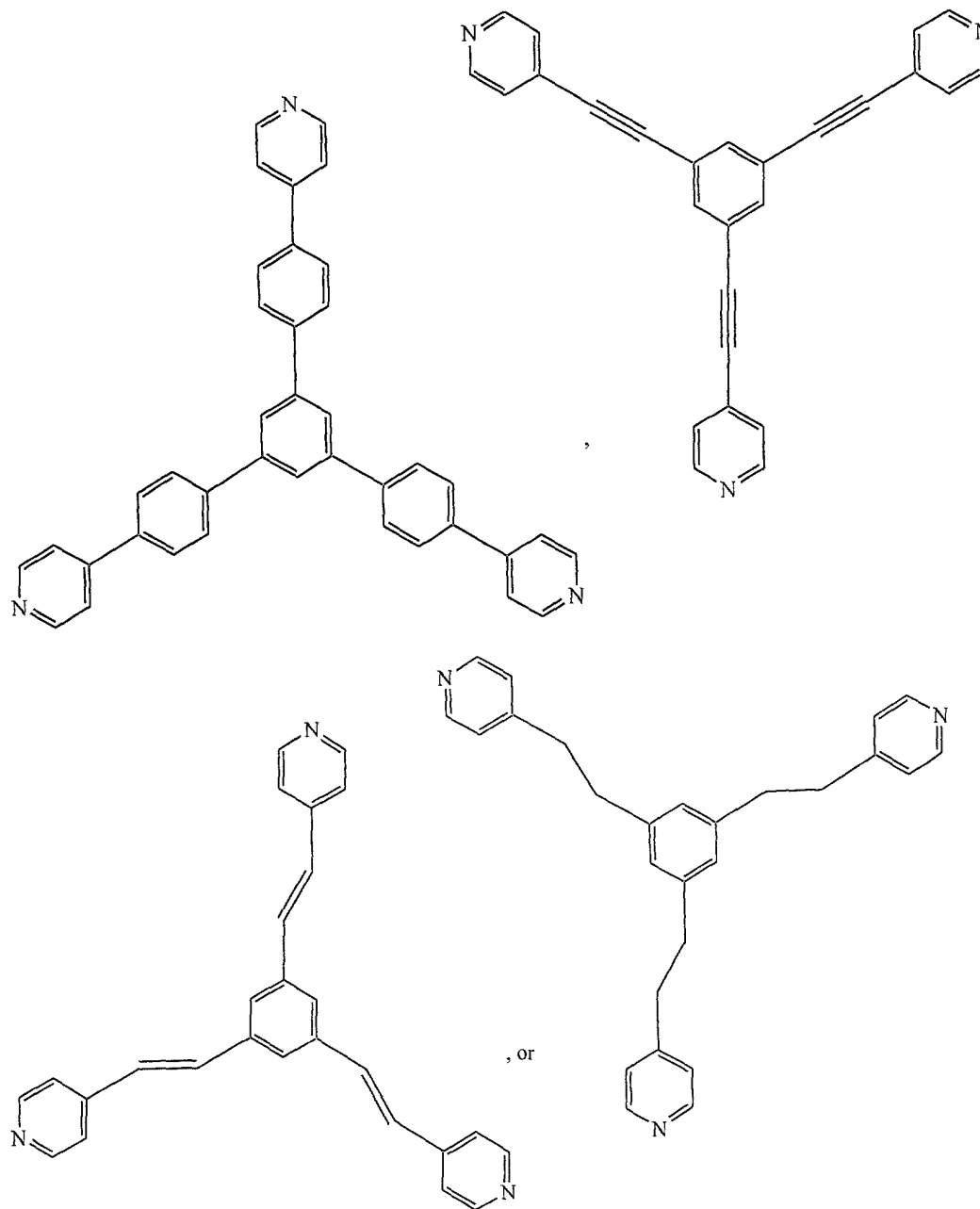
9. The prismatic supramolecule of claim 6, wherein M is Re and m is 3.

10. The prismatic supramolecule of claim 6, wherein R is C<sub>1</sub>~C<sub>16</sub> straight chain alkyl.

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11. The prismatic supramolecule of claim 6, wherein A is O.

12. The prismatic supramolecule of claim 6, wherein X is

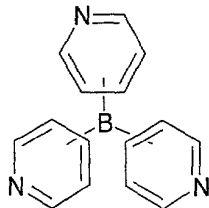


13. A method for making a prismatic supramolecule of claim 1, the method  
 5 comprising reacting  $M(CO)_{m+2}$  with a nitrogen-based tridentate ligand in the presence of an  
 RAH at an elevated temperature to form the prismatic supramolecule, wherein M, m, R, and  
 A are as defined in claim 1.

14. The method of claim 13, wherein M is Re and m is 3.

15. The method of claim 13, wherein RAH is a  $C_1\sim C_{16}$  aliphatic alcohol.

16. The method of claim 13, wherein X is triazine or a ligand of the formula:



5 wherein B is alkyl, alkenyl, alknyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

17. The method of claim 16, wherein X is 1,3,5-triazine.

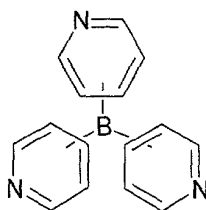
10 18. A composition for emitting luminescence at room temperature, comprising:  
a prismatic supramolecule of claim 1 and an aqueous solution.

19. The composition of claim 18, wherein M is Re and m is 3.

20. The composition of claim 18, wherein R is a  $C_1\sim C_{16}$  aliphatic alkyl.

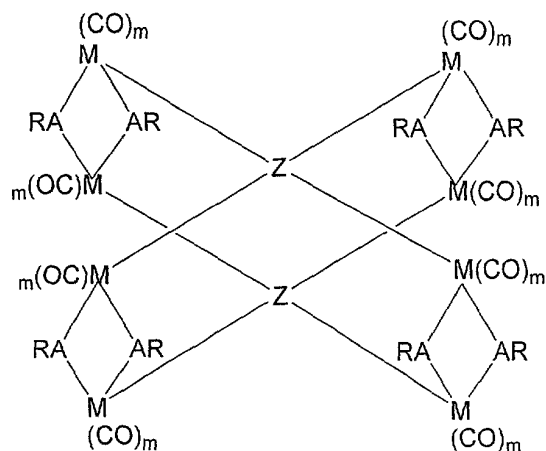
21. The composition of claim 18, wherein A is O.

22. The composition of claim 18, wherein X is triazine or a ligand of the formula:



20 wherein B is alkyl, alkenyl, alknyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

23. A tetragonal prismatic supramolecule having the following structure:



wherein

M is Re, Mn, Cr, Mo, W, Fe, Ru, or Os,

Z is a nitrogen-based tetradentate ligand;

A is O, S, Se, or Te;

R is  $C_1\sim C_{16}$  alkyl,  $(CH_2)_n$ -aryl, or  $(CH_2)_n$ -aryl- $(O-C_1\sim C_{16}$  alkyl) $_p$ , in which n is 0-15, p is 1-3; and

m is 1, 2, 3, 4, or 5.

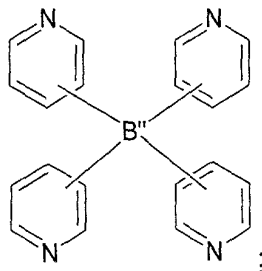
24. The tetragonal prismatic supramolecule of claim 23, wherein M is Re.

25. The tetragonal prismatic supramolecule of claim 24, wherein m is 3.

26. The tetragonal prismatic supramolecule of claim 23, wherein R is  $C_1\sim C_{16}$  straight chain alkyl.

27. The tetragonal prismatic supramolecule of claim 23, wherein A is O.

28. The tetragonal prismatic supramolecule of claim 23, wherein Z is tetrazine or a ligand of the formula:



wherein B'' is alkyl, alkenyl, alknyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

29. The tetragonal prismatic supramolecule of claim 28, wherein B'' is alkenyl,  
5 alknyl, or aryl.

30. The tetragonal prismatic supramolecule of claim 29, wherein Z is 1,2,4,5-tetraethynyl(4-pyridyl)benzene.

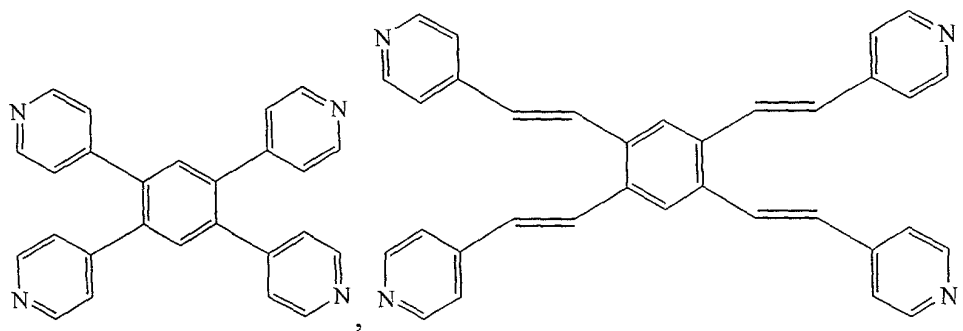
31. The tetragonal prismatic supramolecule of claim 28, wherein M is Re.

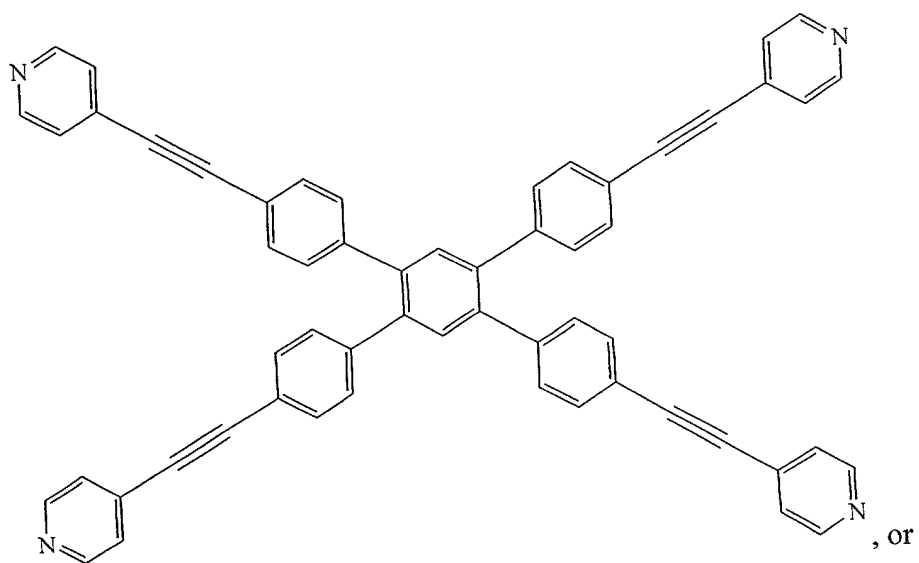
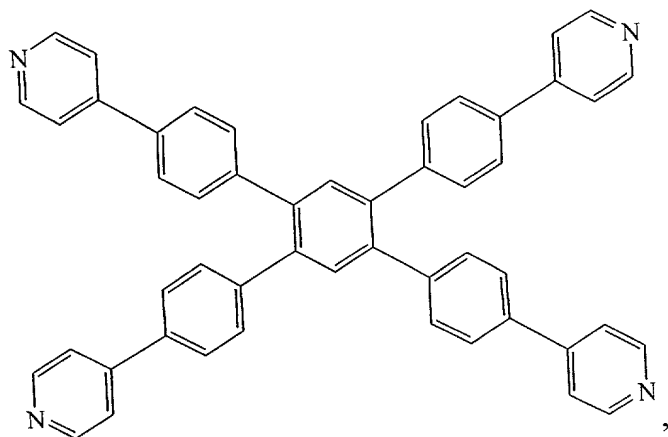
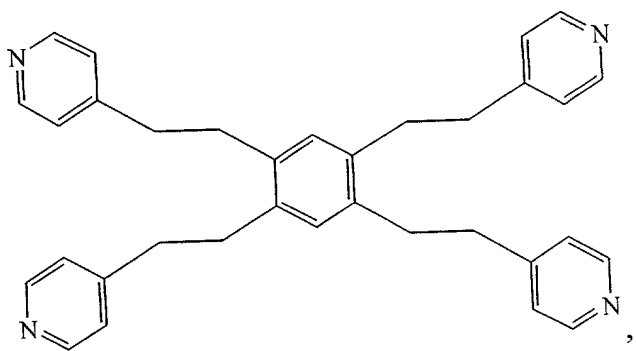
32. The tetragonal prismatic supramolecule of claim 28, wherein m is 3.

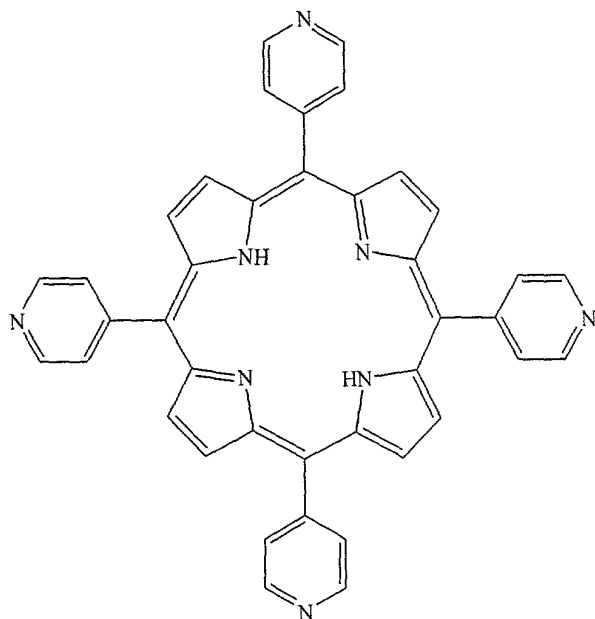
33. The tetragonal prismatic supramolecule of claim 28, wherein R is C<sub>1</sub>~C<sub>16</sub>  
15 straight chain alkyl.

34. The tetragonal prismatic supramolecule of claim 28, wherein A is O.

35. The tetragonal prismatic supramolecule of claim 28, wherein Z is





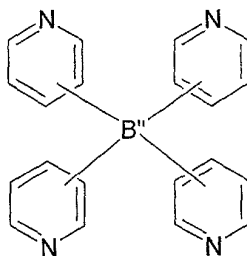


36. A method for making a tetragonal prismatic supramolecule of claim 23, the method comprising reacting  $M(CO)_{m+2}$  with a nitrogen-based tetradentate ligand in the presence of an RAH at an elevated temperature to form the prismatic supramolecule, wherein M, m, R, and A are as defined in claim 23.

37. The method of claim 36, wherein M is Re and m is 3.

38. The method of claim 36, wherein RAH is a  $C_1\sim C_{16}$  aliphatic alcohol.

39. The method of claim 36, wherein Z is tetrazine or a ligand of the formula:



wherein B'' is alkyl, alkenyl, alkynyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

40. A composition for emitting luminescence at room temperature, comprising:



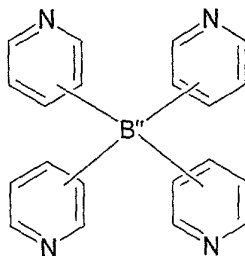
a tetragonal prismatic supramolecule of claim 23 and a solution.

41. The composition of claim 40, wherein M is Re and m is 3.

5 42. The composition of claim 40, wherein R is a  $C_1 \sim C_{16}$  aliphatic alkyl.

43. The composition of claim 40, wherein A is O.

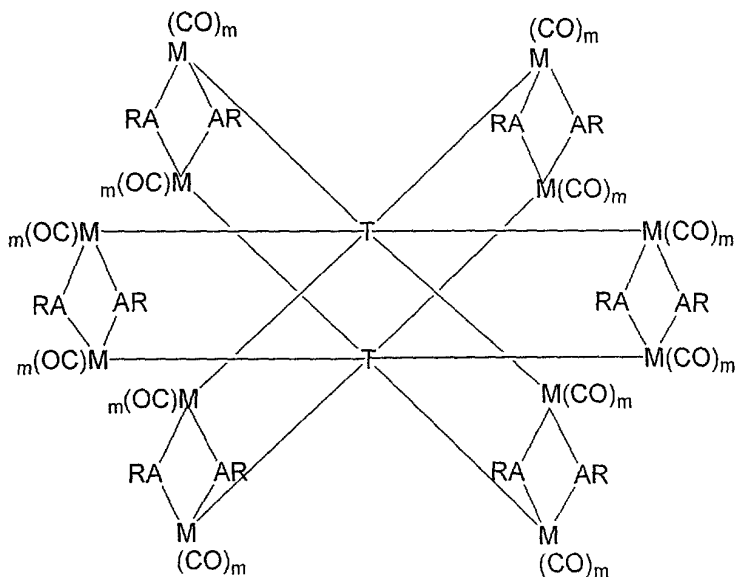
10 44. The composition of claim 40, wherein Z is tetrazine or a ligand of the formula:



wherein B'' is alkyl, alkenyl, alkynyl, cyclyl, heterocyclyl, aryl, or heteroaryl.

15 45. The composition of claim 40, wherein the solution is an aqueous solution.

46. A hexagonal prismatic supramolecule having the following structure:



wherein

M is Re, Mn, Cr, Mo, W, Fe, Ru, or Os,

T is a nitrogen-based hexadentate ligand;

A is O, S, Se, or Te;

R is  $C_1\sim C_{16}$  alkyl,  $(CH_2)_n$ -aryl, or  $(CH_2)_n$ -aryl- $(O-C_1\sim C_{16}$  alkyl) $_p$ , in which n is 0-15, p is 1-3; and

m is 1, 2, 3, 4, or 5.

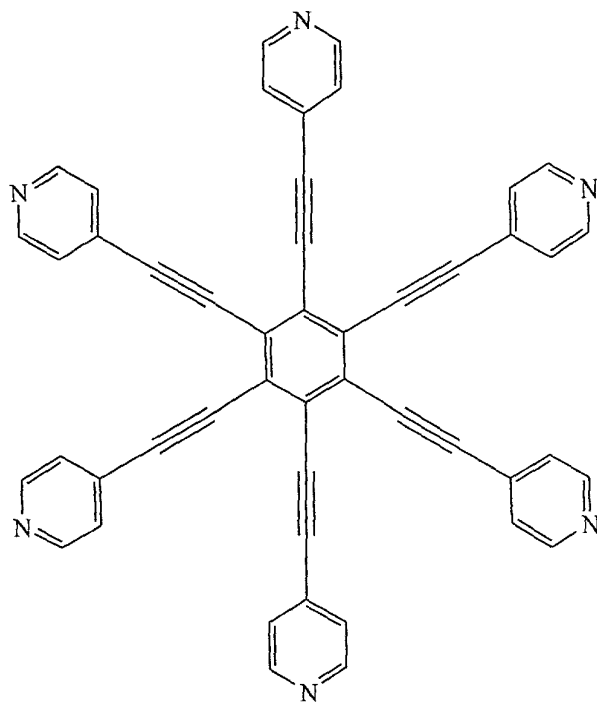
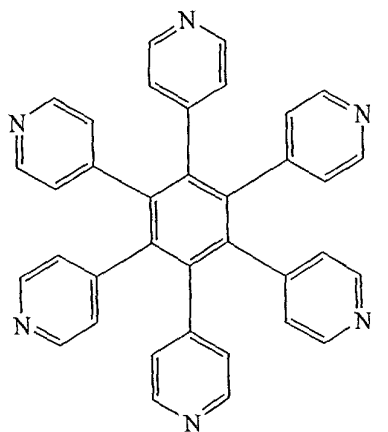
47. The hexagonal prismatic supramolecule of claim 46, wherein M is Re.

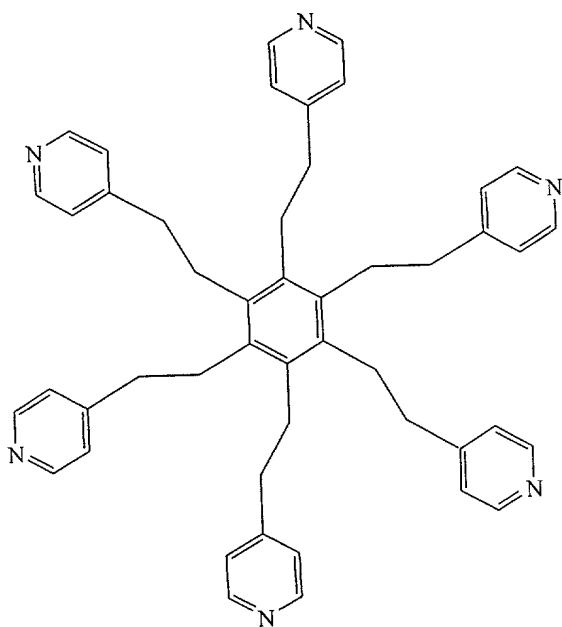
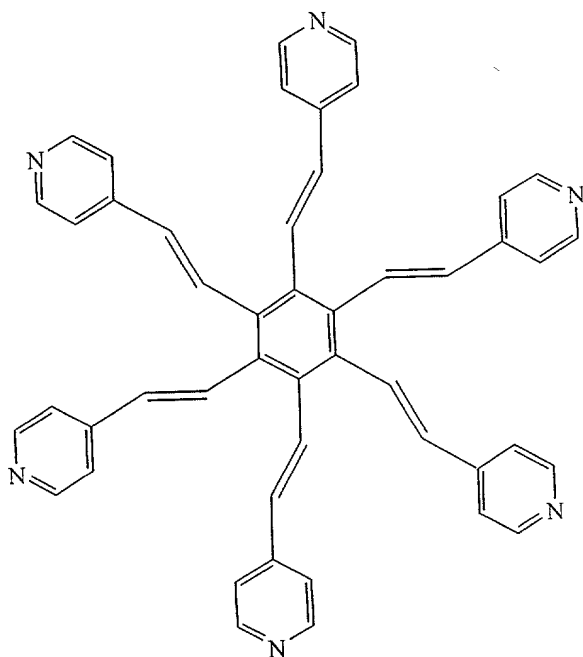
48. The hexagonal prismatic supramolecule of claim 47, wherein m is 3.

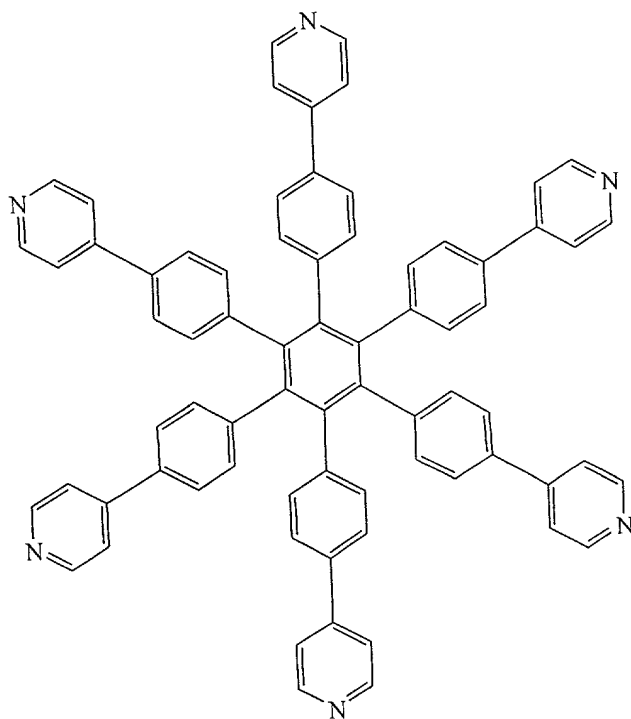
49. The hexagonal prismatic supramolecule of claim 46, wherein R is  $C_1\sim C_{16}$  straight chain alkyl.

50. The hexagonal prismatic supramolecule of claim 46, wherein A is O.

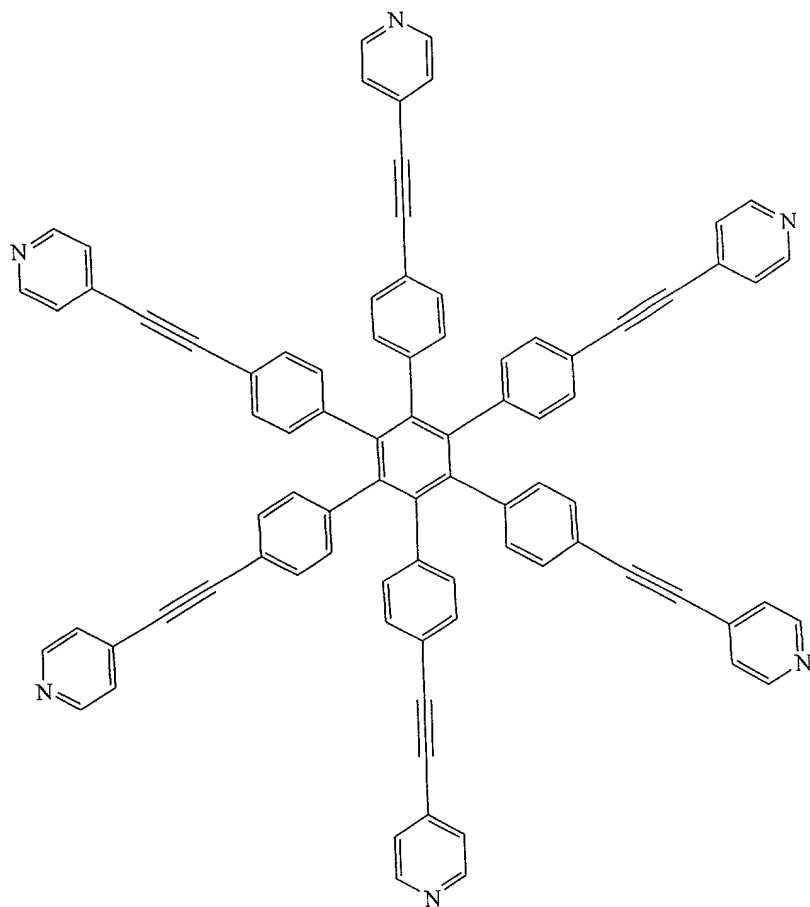
51. The hexagonal prismatic supramolecule of claim 46, wherein T is







, or



52. A method for making a hexagonal prismatic supramolecule of claim 46, the method comprising reacting  $M(\text{CO})_{m+2}$  with a nitrogen-based hexadentate ligand in the presence of an RAH at an elevated temperature to form the hexagonal prismatic supramolecule, wherein M, m, R, and A are as defined in claim 46.

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53. The method of claim 52, wherein M is Re and m is 3.

54. The method of claim 52, wherein RAH is a  $\text{C}_1\sim\text{C}_{16}$  aliphatic alcohol.